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(54) **Dual clutch arrangement**

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Agencement d'embrayage double

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates to a dual clutch arrangement operable to selectively couple two structures such as shafts.

2. Description of Related Prior Art

[0002] It can be desirable to selectively couple two structures, such as shafts, gears, or plates for example, in order to jointly rotate the two structures. The structures can be uncoupled when only one of the structures is to rotate or when the two structures are to rotate at different speeds. A clutch can be operably positioned to couple the two structures to rotate at the same speed. Alternatively, the clutch can be disengaged to allow the two structures to rotate relative to one another.

[0003] US6082511 discloses an outer ring for a one-way clutch which comprises a heat-treated portion a depth of which varies in a direction of a central axis of the outer ring. The heat-treated portion may be located at a raceway surface for torque transmitting members such as sprags.

[0004] GB1060237 discloses a toothed Reduced/Direct two-speed gear for a washing machine, wherein a hollow output shaft integral with a V-belt pulley and coaxially surrounding a gear input extension shaft is selectively clutched to a reduced speed gear member or the input extension shaft. The Direct drive clutch is a coil spring friction clutch which comprises a coil spring frictionally secured to the input shaft extension and contractible or expansible into clutching engagement with the hollow output shaft and is actuated by a spring-returned stationary solenoid through a rotating or non-rotating shift sleeve and at least one shift pin extending axially through the pulley or radially through the hollow output shaft. The Reduced drive clutch between the toothed gear and the pulley may be a plate or dog clutch actuated by a further or the said solenoid, or a double-acting one-way clutch permitting Reverse operation. The gear may provide two speeds when used with a single speed electric driving motor or two speeds for each speed of a multi-speed motor. An epicyclic gear comprises a carrier having planets meshing an input sun and a fixed ring. A solenoid rod has an end directly engaging the sleeve against which is spring-urged a disc carrying pins extending through the pulley. For Reduced drive, the hollow output shaft is connected through the one-way clutch to the carrier, and for Direct drive the solenoid is energized to axially move the pins so that one is engaged by the bent-up end of the contractible spring to clutch the shafts together, the one-way clutch releasing. In a two-speed countershaft gear, one of the pins, directly connected to the sleeve, is engaged by the bent-up end of a drag spring frictionally entrained by a beaker-shaped member which surrounds the contractible clutch spring, is rotatable on the shaft, and has a recess through which projects the clutch spring bent-up end. The sleeve may have a conical bore by which one or more pins radially extending through the hollow shaft are cammed into the path of the bent-up end of a drag spring frictionally entrained by a bush engaged by a clutch spring expansible into engagement with the bore of the hollow shaft. The solenoid may act on the sleeve through a fork having sleeve groove engaging rollers of synthetic plastics. The sleeve, pins and other gear parts may be of synthetic plastics.

SUMMARY OF THE INVENTION

[0005] In summary, the invention is a dual clutch arrangement. The dual clutch arrangement includes a first input rotatable member. The dual clutch arrangement also includes an output rotatable member. The dual clutch arrangement also includes a first clutch coupling the first input rotatable member and the output rotatable member such that the first input rotatable member drives the output rotatable member in rotation. The first clutch is operable to be overrun. The dual clutch arrangement also includes a second input rotatable member. The dual clutch arrangement also includes a second clutch operable to selectively couple the second input rotatable member and the output rotatable member such that the second input rotatable member drives the output rotatable member in rotation. The first clutch is overrun when the second clutch is engaged. The dual clutch arrangement can be one exemplary way of practicing a method of operating a turbine engine to produce thrust for a vehicle, directing air into the turbine engine with a fan during said operating step, and changing a speed of the fan during said operating step to change a bypass ratio of the turbine engine without changing a speed of rotation of a shaft driving the fan.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[0007] Figure 1 is a schematic cross-section of an turbine engine incorporating an exemplary embodiment of the invention;

[0008] Figure 2 is a detailed cross-section of an exemplary embodiment of the invention;

[0009] Figure 3 is a magnified portion of Figure 1 showing a first clutch for coupling an output rotatable member to a first input rotatable member;

[0010] Figure 4 is a magnified portion of Figure 1 showing a second clutch for coupling the output rotatable member to a second input rotatable member;

[0011] Figure 5 is a magnified portion of Figure 1 showing a spline lock mechanism operable to work jointly with the second clutch for coupling the output rotatable member and the second input rotatable member together; and

[0012] Figure 6 is a simplified diagram showing a comparison of velocity profiles.

DETAILED DESCRIPTION OF AN EXEMPLARY EMBODIMENT

[0013] The inventor has developed a dual clutch arrangement that can be practiced in any operating environment in which it is desired to rotate a structure, such as a shaft or any other rotatable member, at different speeds. As set forth below, the invention can be practiced in a turbine engine to vary the rotational speed of a fan. Applying the dual clutch arrangement in a turbine engine allows the turbine engine to be operated in a new and non-obvious method; the bypass ratio of the turbine engine can be changed during operation of the turbine engine by changing the rotational speed of the fan without changing the rotational speed of the shaft driving the fan. The turbine engine can operate with the fan rotating at a relatively lower speed in a first mode of operation and in a second mode of operation with the fan rotting at a relatively higher speed. As a result, the bypass ratio during the first mode of operation is different than the bypass ratio during the second mode of operation. In the first mode of operation, the turbine engine can be operated at a higher level of fuel efficiency and/or at a lower rate of fuel consumption. In the second mode of operation, the turbine engine can be operated at a higher level of thrust output.

[0014] Referring to Figure 1, a turbine engine 10 can include an inlet 12, a first fan 14 and second fan 16. The exemplary fans 14, 16 can be an assembly of, by way of example and not limitation, a disk, a plurality of blades received in slots in the disk, and a retainer. In alternative embodiments, the fan can be a "blisk" wherein the blades and the disk are integral. The turbine engine can also include a compressor section 18, a combustor section 20, and a turbine section 22. The turbine engine 10 can also include an exhaust 24. The fans 14, 16, the compressor section 18, and the turbine section 22 can be arranged to rotate about a centerline axis 26. A working fluid such as air can be drawn into the turbine engine 10 as indicated by the arrows referenced at 28. The fans 14, 16 direct a portion of the working fluid to the compressor section 18 where it is compressed. The fans 14,16 can be viewed as initial compressor stages since the fans 14, 16 impart a pressure increase to the working fluid. The compressed fluid is mixed with fuel and ignited in the combustor section 20. Combustion gases exit the combustor section 20 and flow through the turbine section 22. Energy is extracted from the combustion gases in the turbine section 22.

[0015] Shafts 30, 32 are shown dispose for rotation about the centerline axis 26 of the turbine engine 10. Alternative embodiments of the invention can include any number of shafts. The shafts 30, 32 can be journaled together for relative rotation. The shaft 30 can be a low pressure shaft supporting low pressure turbine blade rows 34, 36 of a low pressure portion of the turbine section 22. In alternative embodiments of the invention, the low pressure shaft 30 can also support compressor blades of a low pressure portion of the compressor section 18.

[0016] The shaft 32 can encircle the shaft 30. As set forth above, the shafts 30, 32 can be journaled together, wherein bearings are disposed between the shafts 30, 32 to permit relative rotation. The shaft 32 can be a high pressure shaft supporting high pressure turbine blade rows 38, 40 of a high pressure portion of the turbine section 22. In the exemplary embodiment, the shaft 32 can also support the blade rows of the compressor section 18. The high pressure portion of the turbine section 22 can thus drive the multi-stage compressor section in the exemplary embodiment. It is noted that this arrangement is not required of the broader invention.

[0017] It is noted that either shaft 30, 32 can drive other structures, such as a gear train, a fan, one or more propeller shafts, a rotor, a tower shaft or any other shaft, or any other structure. In the schematic view of Figure 1, the low pressure shaft 30 can be coupled to a gear assembly 42. The gear assembly 42 can generate rotational output at a speed reduced from the speed of the shaft 30. By ay of example and not limitation, the gear assembly 42 can be a dual planetary arrangement with a center gear for receiving input from the shaft 30 and at least one orbiting gear mated with the center gear for delivering output. The rotational output can be derived directly from the orbiting gear or from a carrier coupled to the center of rotation of the orbiting gear. It is noted that other arrangements for extracting power from the shaft 30, or any other input shaft can be applied in other embodiments of the invention.

[0018] The fans 14, 16 can also direct a portion of the working fluid to a bypass duct 44. The bypass duct 44 can be an annular gap between a compressor casing 46 of the compressor section 18 and an outer casing or nacelle 48 of the turbine engine 10. Bypass flow passes through the bypass duct 44 and may or may not rejoin the portion of the flow that passes through the core engine (the compressor section 18, the combustor section 20, and the turbine section 22). The bypass flow and the core engine flow can join upstream of the exhaust 24 through an integrated propelling nozzle 50 as shown in Figure 1. Alternatively, the bypass flow and core engine flow can exit the turbine engine 10 through separate propelling nozzles.

[0019] The bypass ratio of the turbine engine is the ratio between the mass flow rate of air passing through the core engine and the mass flow rate of air passing through the bypass duct. If the fan 14 drives two kilograms of air around the core engine and into the bypass duct 44 for every kilogram that passes through the core engine, the engine is said to have a bypass ratio of 2, or 2:1. Thus, in a bypass ratio of "2:1" the first number can correspond to the mass flow rate of air passing through the bypass duct 44 and the second number can correspond to the mass flow rate of air passing through the core engine.

[0020] Generally, bypass ratios can range from 0 to 17. A relatively high bypass ratio, such as 11 - 17, is generally associated with civilian aircraft. In addition, a relatively high bypass ratio can result in relatively lower exhaust speed but also in reduced fuel consumption. Relatively high bypass ratios are also generally associated with lower noise, since the relatively large flow of air surrounding the exhaust from the core engine helps to buffer the noise produced by the core engine flow. A lower bypass ratio, such as 0 to 2, generally results in higher exhaust speed and increased fuel consumption. A lower bypass ratio is generally desirable to sustain higher airspeeds and is associated with military aircraft.

[0021] The mass flow rates of air passing through the core engine and through the bypass duct 44 are related to the cross-sectional area of the respective inlets of the core engine and the bypass duct 44. The inlet of the core engine is referenced schematically at 52 and the inlet of the bypass duct 44 is referenced schematically at 54. The mass flow rates are also related to the mean or generalized velocities of the air entering the respective inlets 52, 54. The fan 16 can impart a pressure increase to the working fluid and this pressure increase is manifest by the velocity of the working fluid. As set forth below, the speed of rotation of the fan 16 can be varied and, as a result, the velocity of the working fluid can change during operation. Further, the bypass ratio can change when the generalized velocities of the air entering the respective inlets 52, 54 change.

[0022] Figure 1 schematically shows the fan 16 coupled to two clutches 56, 58. Figure 2 shows a detailed cross section of an exemplary embodiment. A first rotatable output member such as the shaft 30 can be coupled to a first shaft member 60 and be operable to rotate about the centerline axis 26. The first shaft member 60 can be driven in rotation about the centerline axis 26 through a connection defined by the first clutch 56. In the exemplary embodiment of the invention, the first clutch 56 is a sprag clutch having an inner race 62. The first shaft member 60 can define an outer race of the first clutch 56. The first clutch 56 can also include a plurality of individual sprags 64 positioned between the inner race 62 and the first shaft member 60.

[0023] Referring now to Figure 3, the inner race 62 can be fixed for rotation with an inner sleeve 66 driven in rotation by the gear assembly 42. The inner race 62 can be fixed to the sleeve 66 by a spanner nut 68. Thus, when the sleeve 66 rotates, the inner race 62 can rotate. When the inner race 62 rotates, the sprags 64 can engage the first shaft member 60 and cause the first shaft member 60 to rotate. Bearings 70 and 72 can be positioned between the inner race 62 and the first shaft member 60. A seal 74 can be operable to at least partially seal the cavity defined between the inner race 62 and the first shaft member 60. The first shaft member 60 can be supported from a radially outward direction by a stationary structure 76 and a bearing 78.

[0024] In the exemplary embodiment of the invention, the rotation of the first shaft member 60 through the first clutch 56 can produce a particular output speed for the first shaft member 60, such as a low-speed mode of operation. The first shaft member 60 can be fixed for rotation with a second shaft member 80 through at least one bolt 82. Referring to Figure 2 again, the second shaft member 80 can be fixed for rotation with a third shaft member 84 through at least one bolt 86. The third shaft member 84 can be fixed for rotation, directly or indirectly, to fan 16. Thus, the fan 16 can be driven in rotation by the shaft 30 through the gear assembly 42 (shown in Figures 1 and 3), the first clutch 56, and the shaft members 60, 80, 84. The shaft members 60, 80, 84 can jointly define an output rotatable member for driving the fan 16. The sleeve 66 can define a first input shaft coupled to the output rotatable member or shaft defined by the shaft members 60, 80, 84. It is noted that these shafts are exemplary and other configurations of rotationally driving and rotationally driven structures can be applied in alternative embodiments of the invention.

[0025] The fan 16 and the shaft members 60, 80, 84 can also be selectively coupled directly to the shaft 30 to rotate at relatively high speeds. The second clutch 58 can be operably disposed to selectively couple the output shaft defined by the shaft members 60, 80, 84 with the shaft 30. In the exemplary embodiment of the invention, the second clutch 58 can be a friction plate clutch having a first pressing plate defined by the shaft member 80, a second pressing plate 88, and a plurality of friction plates such as friction plate 90 positioned between the first pressing plate defined by the shaft member 80 and the second pressing plate 88.

[0026] The second clutch 58 can be disengaged during the low-speed mode of operation for the output shaft defined by the shaft members 60, 80, 84 in the exemplary embodiment of the invention. The second clutch 58 can be engaged when a high-speed mode of operation for the output shaft defined by the shaft members 60, 80, 84 is desired. Referring now to Figure 4, the second clutch 58 can include an actuator 92 for moving the pressing plates 80 and 88 closer to one another to press the friction plates. The actuator 92 can include first and second links 94 and 96. The first link 94 can be guided in sliding movement by a stationary structure 98. The first link 94 can be moved by any means, including electrically, hydraulically, or pneumatically by a source of power 100 (shown schematically).

[0027] The first link 94 can be moved in a direction represented by an arrow 102 to move the second link 96 and the pressing plate 88 toward the pressing plate 80, thereby increasing the frictional forces between the friction plates. A spring 104 can bias the first link 94 in a direction opposite to the arrow 56 when the actuator 92 is disengaged. A bearing 106 can be disposed between the first and second links 94, 96 to allow the second link 96 and the pressing plates 80, 88 to rotate relative to the first link 94.

[0028] The exemplary second clutch 58 can include friction plates 108, 110, 112, 114 fixed to an extension 116 of the shaft 30. The shaft 30 and the extension 116 are fixed for rotation together. In the exemplary embodiment of the invention, the shaft 30 and the extension 116 are separately formed structures, but could be integral in alternative embodiments of the invention. Thus, the friction plates 108, 110, 112, 114 and the shaft 30 can be fixed for rotation together through the connection between the friction plates 108, 110, 112, 114 and the extension 116.

[0029] The exemplary second clutch 58 can also include friction plates 118, 120, 122, 124 fixed to the pressing plate 80. The pressing plate 80 and the friction plates 118, 120, 122, 124 can be fixed for rotation together. When the pressing plates 80, 88 are urged together, the friction plates (numbered and unnumbered in the drawings) are pressed together. Referring again to Figure 2, the friction between the friction plates increases, resulting in engagement of the second clutch 58 and rotation of the output shaft defined by the shaft members 60, 80, 84 and shaft 30 at the same speed.

[0030] When the second clutch 58 is engaged, the first shaft member 60 can over-run the first clutch 56. In other words, the first shaft member 60 can rotate faster than the inner sleeve 66 (shown in Figure 3) and the inner race 62 without damaging the first clutch 56. The inner sleeve 66 and the inner race 62 can continue to be driven in rotation by the gear assembly 42; this rotation is lost motion. Thus, the exemplary embodiment allows the fan 16 to be selectively driven along at least two separate paths of power transmission from the low pressure shaft 30, a source of rotational power, of the turbine engine 10. In alternative embodiments of the invention, more than two paths of power transmission can be defined if desired.

[0031] It is noted that in the exemplary embodiment the outer race 60 of the first clutch 56 and a first pressing plate 80 of the second clutch 58 can be fixed directly together for concurrent rotation. In alternative embodiments of the invention, the outer race 60 of the first clutch 56 and a first pressing plate 80 of the second clutch 58 can be integral. It is also noted that in the exemplary embodiment the forward fan 14 can be driven only by the shaft 30. In alternative embodiments of the broader invention, the fan 14 can be driven along more than path of power transmission.

[0032] As shown by the exemplary embodiment, the first and second clutches 56, 58 can be disposed on opposite sides of the output shaft along the centerline axis 26. Also, the first and second clutches 56, 58 can be spaced different distances from the axis 26. It is noted that that the first and second clutches 56, 58 can be radially stacked in alternative embodiments of the invention, wherein the first and second clutches 56, 58 would generally overlap along the axis 26.

[0033] Referring again to Figure 2, the exemplary embodiment of the invention can also include a lock mechanism 126. The lock mechanism 126 can be similar to the design disclosed in U.S. Patent Application Publication No. 2007/0189848, which is hereby incorporated by reference. Referring not to Figure 5, the lock mechanism 126 can include a plurality of spline sections 128, 130 defined by the extension 116. The lock mechanism 126 can be desirable in operating environments in which relatively high levels of torque are to be transmitted between the output shaft defined by the shaft members 60, 80, 84 and shaft 30. The lock mechanism 126 can also include a member 132 fixed for rotation with the pressing plate 88 and therefore fixed for rotation with the output shaft defined by the shaft members 60, 80, 84. The member 132 can thus be part of the output shaft.

[0034] The member 132 can define a spline section 134. The lock mechanism 126 can include a moveable locking portion 136 operable to selectively lock the extension 116 and the member 132 together through the respective spline sections 82, 84, and 88. The exemplary locking portion 136 can include a first link 138, a second link 140, and a locking sleeve 142. The first link 138 can be guided in sliding movement by the stationary structure 98. The first link 138 can be moved by any means, including electrically, hydraulically, or pneumatically by a source of power 144 (shown schematically).

[0035] The first link 138 can be moved in a direction represented by an arrow 146 to move the second link 140 in the direction represented by the arrow 146. A spring 148 can bias the first link 138 in a direction opposite to the arrow 146 when the lock mechanism 126 is disengaged. A bearing 150 can be disposed between the first and second links 138, 140 to allow the second link 140 to rotate relative to the first link 138. The second link 140 can define a spline section 152 that engages the spline section 134 to guide axial movement of second link 140. Thus, the second link 140 can be coupled to the member 132 for rotation together and is therefore coupled to the output shaft defined by the shaft members 60, 80, 84 as well.

[0036] The second link 140 and the locking sleeve 142 can be engaged for relative movement. In the exemplary embodiment of the invention, the second link 140 and the locking sleeve 142 can move relative to one another axially. A spring 154 can be disposed between the second link 140 and the locking sleeve 142. In operation, the first and second links 138, 140 can be moved axially in the direction represented by the arrow 146 by movement of the first link 138. When spline sections 156 and 158 of the locking sleeve 142 abut the spline sections 128, 130 of the extension 116, respectively, the locking sleeve 142 can stop moving if the confronting spline sections 156 - 128 and 158 - 130 are not radially aligned. The spring 154 can then compress, biasing the locking sleeve 142 in the direction represented by the arrow 146.

[0037] As the spring 154 is compressed, the locking sleeve 142 can rotate relative to the second link 140. The locking sleeve 142 and the second link 140 by respective, mating helical splines, referenced at 160. The locking sleeve 142 can continue rotating relative to the second link 140 until the confronting spline sections 156 - 128 and 158 - 130 become aligned. When that occurs, the load generated the spring 154 can urge the confronting spline sections 156 - 128 and 158 - 130 into mating engagement. The confronting spline sections 156 - 128 and 158 - 130 can snap into place and lock together the member 132, the second link 140, the locking sleeve 142, and extension 116. Through this linkage, the output shaft defined by the shaft members 60, 80, 84 and the shaft 30 are locked together for the transmission of relatively high torque loads.

[0038] The second link 140 and the locking sleeve 142 can thus define a locking ring assembly movable along the axis 26 between a locked position and an unlocked position. The spline section 152 can define a first locking portion extending radially from the locking ring assembly circumferentially about the axis 26 for engaging the output shaft. The spline section 156 can define a second locking portion extending radially from the locking ring assembly opposite the first locking portion circumferentially about the axis 26 for engaging the shaft 30 (through the extension 116 in the exemplary embodiment). The spline section 158 can define a third locking portion spaced from the second locking portion along the axis 26 and extending radially from the locking ring assembly opposite the first locking portion circumferentially about the axis 26 for engaging the shaft 30 (through the extension 116 in the exemplary embodiment).

[0039] In the exemplary embodiment, the fan 16 can be driven in rotation along at least two separate paths of power transmission. The first path extends from the shaft 30 and through the gear arrangement 42 and the first clutch 56. The second path extends from the shaft 30 and through the second clutch 56. As a sprag clutch, the first exemplary clutch 56 can positively lock the fan 16 when the fan 16 is being driven along the first path. In other words, the output shaft defined by the shaft members 60, 80, 84 does not slip when driven through the first path. A sprag clutch is a positive-locking clutch. The exemplary second clutch 58 can be supplemented by the exemplary lock mechanism 126, which is structurally distinct from the exemplary second clutch 58. Thus, the output shaft and fan 16 can be positively locked when the fan 16 is being driven along any of the paths of power transmission.

[0040] Referring again to Figure 1, changing the speed of the output shaft driving the fan 16 during operation causes the bypass ratio to change without changing the speed of the shaft 30. The bypass ratio is at least partially dependent on the velocity of the air flow entering the respective inlets 52, 54. Figure 6 is a simplified diagram showing a comparison of velocity profiles. A point 162 represents a radial outer edge of a hub of the fan 16. Generally, the velocity of the air directed by the fan is minimal at point 162. A point 164 represents a radial outer edge of blades of the fan 16. Generally, the velocity of the air directed by the fan is maximized at point 164.

[0041] When the fan 16 and the output shaft defined by the shaft members 60, 80, 84 (shown in Figure 2) are driven in rotation at a relatively lower speed, through the first clutch 56 (shown in Figure 1), the velocity of the air at the radial outer edge of blades of the fan 16 is represented by a vector 166, extending between the point 164 and a point 168. A first portion of the air flow will pass into the bypass duct 44 and a second portion of the air flow will pass into the compressor section 18. An average or mean velocity of the first portion air passing into the bypass duct 44 is represented by a vector 170, extending between a point 172 and a point 174. An average or mean velocity of the second portion air passing into the compressor section 18 is represented by a vector 176, extending between a point 178 and a point 180.

[0042] When the fan 16 and the output shaft defined by the shaft members 60, 80, 84 (shown in Figure 2) are driven in rotation at higher speed, through the second clutch 58 (shown in Figure 1), the velocity of the air at the radial outer edge of blades of the fan 16 is represented by a vector 182, extending between the point 164 and a point 184. An average or mean velocity of the first portion air passing into the bypass duct 44 during high-speed operation is represented by a vector 186, extending between the point 172 and a point 188. An average or mean velocity of the second portion air passing into the compressor section 18 during high-speed operation is represented by a vector 190, extending between the point 178 and a point 192.

[0043] Figure 6 shows that the relative change in velocity is greater for the first portion of air, the air directed into the bypass duct 44. Arrow 194 represents the difference in magnitude between the velocities of air streams passing into the bypass duct 44 at low-speed and high-speed operations. Arrow 196 represents the difference in magnitude between the velocities of air streams passing into the compressor section 18 at low-speed and high-speed operations. The arrow 194 is larger than the arrow 196. Thus, the rate at which velocity changes for air passing into the bypass duct 44 is greater than the rate at which velocity changes for air passing into the compressor section 18 when the operation of the engine changes between low-speed and high-speed operations. In a graph correlating mass flow rate along the y-axis over fan rotation speed along the x-axis, the respective curves for the first and second portions of air flow would not be parallel. The curve for the first portion of air, the portion directed to the bypass duct 44, would be steeper than the curve for the second portion of air, the portion directed to the compressor section 18.

[0044] It is also noted that other mechanisms and approaches can be applied in conjunction with the exemplary embodiment to modify the bypass ratio. For example, additional valves/vanes can be positioned relative to the bypass duct 44 to adjust the mass flow rate of air through the bypass duct 44. Also, bypass flow can be diverted downstream of the inlet 54 to adjust the mass flow rate of air through the bypass duct 44.

Claims

1. A dual clutch arrangement comprising:

a first input rotatable member (66);
an output rotatable member (60, 80, 84);
a first clutch (56) coupling said first input rotatable member and said output rotatable member such that said first input rotatable member drives said output rotatable member in rotation, wherein said first clutch is operable to be overrun;
characterised in that the dual clutch arrangement further comprises a second input rotatable member (30); and
a second clutch (58) operable to selectively couple said second input rotatable member and said output rotatable member (16) such that said second input rotatable member drives said output rotatable member in rotation, wherein said first clutch (56) is overrun when said second clutch is engaged.

2. The dual clutch arrangement of claim 1 further comprising:

a gearing arrangement (42) operably positioned between said second input rotatable member (66) and said first input rotatable member (30), such that said second input rotatable member drives said first input rotatable member and that said gearing arrangement (42) transmits rotation to said first input rotatable member at a reduced speed relative to said second input rotatable member.

3. The dual clutch arrangement of claim 1 wherein said output rotatable member (60, 80, 84) is operable to rotate about a first axis of rotation (26) and wherein said first and second clutches (56, 58) are disposed on opposite sides of said output rotatable member (60, 80, 84) along said first axis of rotation.

4. The dual clutch arrangement of claim 1 wherein said first clutch (56) is a sprag clutch and said second clutch (58) is a friction plate clutch, wherein an outer race of said first clutch (56) and a first pressing plate (80) of said second clutch (58) are fixed directly together for concurrent rotation.

5. The dual clutch arrangement of claim 1 further comprising:

a lock mechanism (126) operable to couple said output and second input rotatable members for rotation together when said second clutch (58) is engaged to increase an amount of torque transmitted between said output and second input rotatable members.

6. The dual clutch arrangement of claim 5 wherein said lock mechanism (126) further comprises:

a locking ring assembly movable along an axis of rotation of said output rotatable member (16) between a locked position and an unlocked position;
a first locking portion extending radially from said locking ring assembly circumferentially about said axis of rotation for engaging one of said output rotatable member (60, 80, 84) and said second input rotatable member;
a second locking portion extending radially from said locking ring assembly opposite said first locking portion circumferentially about said axis of rotation for engaging the other of said output rotatable member (60, 80, 84) and said second input rotatable member; and
a third locking portion spaced from said second locking portion along said axis of rotation and extending radially from said locking ring assembly opposite said first locking portion circumferentially about said axis of rotation for engaging the other of said output rotatable member (60, 80, 84) and said second input rotatable member.

7. The dual clutch arrangement of claim 5 wherein said lock mechanism (126) is further defined as being structurally distinct from said second clutch (58).

8. The dual clutch arrangement of claim 1 wherein said output rotatable member (60, 80, 84) is operable to rotate about a first axis of rotation (26) and wherein said first and second clutches (56, 58) are disposed spaced differently from said first axis of rotation.

9. A turbine engine (10) comprising the dual clutch arrangement of claim 1, and further comprising:

a compressor section (18);
a bypass duct (44) encircling said compressor section and extending along a centerline axis (26) of the turbine engine; and
a first fan (16) operable to direct air into said compressor section and said bypass duct (44);
wherein the output rotatable member (60, 80, 84) is an output shaft coupled to said first fan (16);
the first input rotatable member (66) is a first input shaft; and
the second input rotatable member (30) is a second input shaft.

10. The turbine engine of claim 9 wherein said first clutch (56) is positioned aft of said first fan (16) and said second clutch (58) is positioned forward of said first clutch (56) along said centerline axis (26).

11. The turbine engine of claim 9 further comprising:

a gear assembly (42) operable to transmit power to the first input shaft from a low pressure shaft of the turbine engine.

12. The turbine engine of claim 11 wherein said second input shaft is further defined as said low pressure shaft.

13. The turbine engine of claim 9 further comprising:

a second fan (14) positioned forward of the first fan (16) and driven in rotation by said second input shaft (30).

14. The turbine engine of claim 9 further comprising:

a lock mechanism (126) operable to selectively couple said output and second input shafts for rotation together when said second clutch (58) is engaged to increase an amount of torque transmitted between said output and second input shafts.

15. A method comprising the steps of:

operating a turbine engine (10) to produce thrust for a vehicle;
directing air into the turbine engine with a first fan (16) during said operating step;
driving the fan in rotation with a low pressure shaft (30) of the turbine engine; and
changing a speed of the first fan (16) during said operating step to change a bypass ratio of the turbine engine (10) without changing a speed of rotation of the low pressure shaft (30).

16. The method of claim 15 further comprising the step of:

selectively driving the first fan (16) through at least two separate paths of power transmission from the low pressure shaft (30).

17. The method of claim 15 further comprising the steps of:

disposing a second fan (14) forward of the first fan (16) along a centerline axis (26) of the turbine engine (10);
driving the first fan (16) through at least two separate paths of power transmission; and
driving the second fan (14) through a fewer number of paths of power transmission than the paths of power driving the first fan (16).

18. The method of claim 15 further comprising the step of:

driving the first fan (16) through at least two separate paths of power transmission; and
positively locking the first fan (16) when the first fan (16) is being driven through any of the at least two separate paths of power transmission.

19. The method of claim 1.9 wherein said positively locking step includes the steps of:

locking the first fan (16) for rotation through a first path of power transmission through a positive-locking clutch (56); and
locking the first fan (16) for rotation through a second path of power transmission through a lock mechanism (126) distinct from a clutch (58) disposed along the second path of power transmission.

20. The method of claim 19 further comprising the step of:

activating the clutch (58) disposed along the second path of power transmission and the lock mechanism (126) with separate actuators.

Patentansprüche

1. Doppelkupplungsanordnung, die Folgendes umfasst:

ein erstes drehbares Antriebselement (66),
ein drehbares Abtriebselement (60, 80, 84),
eine erste Kupplung (56), die das erste drehbare Antriebselement und das drehbare Abtriebselement derart koppelt, dass das erste drehbare Antriebselement das drehbare Abtriebselement in Drehung antreibt, wobei die erste Kupplung funktionsfähig ist, um freizulaufen,
dadurch gekennzeichnet, dass die Doppelkupplungsanordnung ferner ein zweites drehbares Antriebselement (30) umfasst, und
eine zweite Kupplung (58), die funktionsfähig ist, um selektiv das zweite drehbare Antriebselement und das drehbare Abtriebselement (16) derart zu koppeln, dass das zweite drehbare Antriebselement das drehbare Abtriebselement in Drehung antreibt, wobei die erste Kupplung (56) freiläuft, wenn die zweite Kupplung in Eingriff gebracht ist.

2. Doppelkupplungsanordnung nach Anspruch 1, die ferner Folgendes umfasst:

eine Getriebeanordnung (42), die funktionsfähig derart zwischen dem zweiten drehbaren Antriebselement (66) und dem ersten drehbaren Antriebselement (30) angeordnet ist, dass das zweite drehbare Antriebselement das erste drehbare Antriebselement antreibt und dass die Getriebeanordnung (42) eine Drehung mit einer im Verhältnis zu dem zweiten drehbaren Antriebselement verringerten Geschwindigkeit auf das erste drehbare Antriebselement überträgt.

3. Doppelkupplungsanordnung nach Anspruch 1, wobei das drehbare Abtriebselement (60, 80, 84) funktionsfähig ist, um sich um eine erste Drehachse (26) zu drehen, und wobei die erste und die zweite Kupplung (56, 58) auf entgegengesetzten Seiten des drehbaren Abtriebselements (60, 80, 84) entlang der ersten Drehachse angeordnet sind.

4. Doppelkupplungsanordnung nach Anspruch 1, wobei die erste Kupplung (56) eine Freilaufkupplung ist und die zweite Kupplung (58) eine Reibplattenkupplung ist, wobei ein äußerer Laufring der ersten Kupplung (56) und eine erste Druckplatte (80) der zweiten Kupplung (58) für eine gleichzeitige Drehung unmittelbar aneinander befestigt sind.

5. Doppelkupplungsanordnung nach Anspruch 1, die ferner Folgendes umfasst:

einen Verriegelungsmechanismus (126), der funktionsfähig ist, um das Abtriebs- und das zweite drehbare Antriebselement für eine Drehung miteinander zu koppeln, wenn die zweite Kupplung (58) in Eingriff gebracht ist, um ein Ausmaß des zwischen dem Abtriebs- und dem zweiten drehbaren Antriebselement übertragenen Drehmoments zu steigern.

6. Doppelkupplungsanordnung nach Anspruch 1, wobei der Verriegelungsmechanismus (126) ferner Folgendes umfasst:

eine Vernegelungsring-Baugruppe, die entlang einer Drehachse des drehbaren Abtriebselements (16) zwischen einer verriegelten Stellung und einer entriegelten Stellung beweglich ist,
einen ersten Verriegelungsabschnitt, der sich in Radialrichtung von der Vernegelungsring-Baugruppe aus umlaufend um die Drehachse erstreckt, um das eine von dem drehbaren Abtriebselement (60, 80, 84) und dem zweiten drehbaren Antriebselement in Eingriff zu nehmen,
einen zweiten Verriegelungsabschnitt, der sich entgegengesetzt zu dem ersten Verriegelungsabschnitt in Radialrichtung von der Verriegelungsring-Baugruppe aus umlaufend um die Drehachse erstreckt, um das andere von dem drehbaren Abtriebselement (60, 80, 84) und dem zweiten drehbaren Antriebselement in Eingriff zu nehmen, und
einen dritten Verriegelungsabschnitt, der entlang der Drehachse von dem zweiten Verriegelungsabschnitt beabstandet und sich entgegengesetzt zu dem ersten Verriegelungsabschnitt in Radialrichtung von der Verriegelungsring-Baugruppe aus umlaufend um die Drehachse erstreckt, um das andere von dem drehbaren Abtriebselement (60, 80, 84) und dem zweiten drehbaren Antriebselement in Eingriff zu nehmen.

7. Doppelkupplungsanordnung nach Anspruch 5, wobei der Verriegelungsmechanismus (126) ferner so definiert ist, dass er strukturell von der zweiten Kupplung (58) unterschieden ist.

8. Doppelkupplungsanordnung nach Anspruch 1, wobei das drehbare Abtriebselement (60, 80, 84) funktionsfähig ist, um sich um eine erste Drehachse (26) zu drehen, und wobei die erste und die zweite Kupplung (56, 58) unterschiedlich beabstandet von der ersten Drehachse angeordnet sind.

9. Turbinentriebwerk (10), das die Doppelkupplungsanordnung nach Anspruch 1 umfasst und ferner Folgendes umfasst:

eine Verdichtersektion (18),
eine Umgehungsleitung (44), welche die Verdichtersektion umschließt und sich entlang einer Mittellinienachse (26) des Turbinentriebwerks erstreckt, und
ein erstes Gebläse (16), das funktionsfähig ist, um Luft in die Verdichtersektion und die Umgehungsleitung (44) zu leiten,
wobei das drehbare Abtriebselement (60, 80, 84) eine an das erste Gebläse (16) gekoppelte Abtriebswelle ist,
das erste drehbare Antriebselement (66) eine erste Antriebswelle ist und
das zweite drehbare Antriebselement (30) eine zweite Antriebswelle ist.

10. Turbinentriebwerk nach Anspruch 9, wobei entlang der Mittellinienachse (26) die erste Kupplung (56) hinter dem ersten Gebläse (16) angeordnet ist und die zweite (58) vor der ersten Kupplung (56) angeordnet ist.

11. Turbinentriebwerk nach Anspruch 9, das ferner Folgendes umfasst:

eine Getriebebaugruppe (42), die funktionsfähig ist, um von einer Niederdruckwelle des Turbinentriebwerks Kraft zu der ersten Antriebswelle zu übertragen.

12. Turbinentriebwerk nach Anspruch 11, wobei die zweite Antriebswelle ferner als eine Niederdruckwelle definiert ist.

13. Turbinentriebwerk nach Anspruch 9, das ferner Folgendes umfasst:

ein zweites Gebläse (14), das vor dem ersten Gebläse (16) angeordnet ist und durch die zweite Antriebswelle (30) in Drehung angetrieben wird.

14. Turbinentriebwerk nach Anspruch 9, das ferner Folgendes umfasst:

einen Verriegelungsmechanismus (126), der funktionsfähig ist, um die Abtriebs- und die zweite Antriebswelle für eine Drehung miteinander zu koppeln, wenn die zweite Kupplung (58) in Eingriff gebracht ist, um ein Ausmaß des zwischen der Abtriebs- und der zweiten Antriebswelle übertragenen Drehmoments zu steigern.

15. Verfahren, das die folgenden Schritte umfasst:

das Betreiben eines Turbinentriebwerks (10), um Schub für ein Fahrzeug zu erzeugen,
das Leiten von Luft in das Turbinentriebwerk mit einem ersten Gebläse (16) während des Betriebsschrittes,
das Antreiben des Gebläses mit einer Niederdruckwelle (30) des Turbinentriebwerks und
das Verändern einer Geschwindigkeit des ersten Gebläses (16) während des Betriebsschrittes, um ein Umgehungsverhältnis des Turbinentriebwerks (10) zu verändern, ohne eine Drehgeschwindigkeit der Niederdruckwelle (30) zu verändern.

16. Verfahren nach Anspruch 15, das ferner den folgenden Schritt umfasst:

das selektive Antreiben des ersten Gebläses (16) durch wenigstens zwei gesonderte Wege der Kraftübertragung von der Niederdruckwelle (30).

17. Verfahren nach Anspruch 15, das ferner die folgenden Schritte umfasst:

das Anordnen eines zweiten Gebläses (14) vor dem ersten Gebläse (16) entlang einer Mittellinienachse (26) des Turbinentriebwerks (10),
das Antreiben des ersten Gebläses (16) durch wenigstens zwei gesonderte Wege der Kraftübertragung und
das Antreiben des zweiten Gebläses (14) durch eine Zahl von Wegen der Kraftübertragung, die geringer ist als die der Kraftwege, die das erste Gebläse (16) antreiben.

18. Verfahren nach Anspruch 15, das ferner den folgenden Schritt umfasst:

das Antreiben des ersten Gebläses (16) durch wenigstens zwei gesonderte Wege der Kraftübertragung und
das formschlüssige Verriegeln des ersten Gebläses (16), wenn das erste Gebläse durch einen beliebigen der wenigstens zwei gesonderten Wege der Kraftübertragung angetrieben wird.

19. Verfahren nach Anspruch 18, wobei der Schritt des formschlüssigen Verriegelns die folgenden Schritte einschließt:

das Verriegeln des ersten Gebläses (16) für eine Drehung durch einen ersten Weg der Kraftübertragung durch eine formschlüssige Kupplung (56) und
das Verriegeln des ersten Gebläses (16) für eine Drehung durch einen zweiten Weg der Kraftübertragung durch einen Verriegelungsmechanismus (126), verschieden von einer entlang des zweiten Weges der Kraftübertragung angeordneten Kupplung (58).

20. Verfahren nach Anspruch 19, das ferner den folgenden Schritt umfasst:

das Aktivieren der entlang des zweiten Weges der Kraftübertragung angeordneten Kupplung (58) und des Verriegelungsmechanismus (126) mit gesonderten Stellantrieben.

Revendications

1. Agencement à double embrayage, comprenant :

un premier élément rotatif d'entrée (66) ;
un élément rotatif de sortie (60, 80, 84) ;
un premier embrayage (56), assurant l'accouplement dudit premier élément rotatif d'entrée et dudit élément rotatif de sortie, de sorte que ledit premier élément rotatif d'entrée entraîne ledit élément rotatif de sortie en rotation, ledit premier embrayage étant destiné à être en roue libre ;
caractérisé en ce que l'agencement à double

embrayage comprend en outre un deuxième élément rotatif d'entrée (30) ; et
un deuxième embrayage (58), destiné à accoupler sélectivement ledit deuxième élément rotatif d'entrée et ledit élément rotatif de sortie (16), de sorte que ledit deuxième élément rotatif d'entrée entraîne ledit élément rotatif de sortie en rotation, dans lequel ledit premier embrayage (56) est en roue libre lorsque ledit deuxième embrayage est engagé.

2. Agencement à double embrayage selon la revendication 1, comprenant en outre :

un assemblage d'engrenage (42), positionné en service entre ledit deuxième élément rotatif d'entrée (66) et ledit premier élément rotatif d'entrée (30), de sorte que ledit deuxième élément rotatif d'entrée entraîne ledit premier élément rotatif d'entrée et que ledit assemblage d'engrenage (42) transmet la rotation vers ledit premier élément rotatif d'entrée à une deuxième vitesse réduite par rapport audit deuxième élément rotatif d'entrée.

3. Agencement à double embrayage selon la revendication 1, dans lequel ledit élément rotatif de sortie (60, 80, 84) est destiné à tourner autour d'un premier axe de rotation (26), et dans lequel lesdits premier et deuxième embrayages (56, 58) sont agencés sur les côtés opposés dudit élément rotatif de sortie (60, 80, 84), le long dudit premier axe de rotation.

4. Agencement à double embrayage selon la revendication 1, dans lequel ledit premier embrayage (56) est un embrayage à roue libre, ledit deuxième embrayage (58) étant un embrayage à disque de friction, une bague extérieure dudit premier embrayage (56) et une première plaque de pression (80) dudit deuxième embrayage (58) étant fixées directement l'une à l'autre en vue d'une rotation simultanée.

5. Agencement à double embrayage selon la revendication 1, comprenant en outre :

un mécanisme de verrouillage (126), destiné à accoupler ledit élément rotatif de sortie et ledit deuxième élément rotatif d'entrée en vue d'une rotation commune lorsque ledit deuxième embrayage (58) est engagé, afin d'accroître une importance de couple transmis entre ledit élément rotatif de sortie et ledit deuxième élément rotatif d'entrée.

6. Agencement à double embrayage selon la revendication 5, dans lequel ledit mécanisme de verrouillage (126) comprend en outre :

un assemblage de bague de verrouillage, pouvant se déplacer le long d'un axe de rotation dudit élément rotatif de sortie (16) entre une position verrouillée et une position déverrouillée ;
une première partie de verrouillage, s'étendant radialement à partir dudit assemblage de bague de verrouillage, circonférentiellement autour dudit axe de rotation, en vue de l'engagement dans l'un des éléments, à savoir ledit élément rotatif de sortie (60, 80, 84) ou ledit deuxième élément rotatif d'entrée ;
une deuxième partie de verrouillage, s'étendant radialement à partir dudit assemblage de bague de verrouillage, opposée à ladite première partie de verrouillage, circonférentiellement autour dudit axe de rotation, en vue de l'engagement dans l'autre élément, ledit élément rotatif de sortie (60, 80, 84) ou ledit deuxième élément rotatif d'entrée ; et
une troisième partie de verrouillage, espacée de ladite deuxième partie de verrouillage le long dudit axe de rotation, et s'étendant radialement à partir dudit assemblage de bague de verrouillage, opposé à ladite première partie de verrouillage, circonférentiellement autour dudit axe de rotation, en vue de l'engagement dans l'autre élément, ledit élément rotatif de sortie (60, 80, 84) ou ledit deuxième élément rotatif d'entrée.

7. Agencement à double embrayage selon la revendication 5, dans lequel ledit mécanisme de verrouillage (126) est en outre défini comme étant structuralement distinct dudit deuxième embrayage (58).

8. Agencement à double embrayage selon la revendication 1, dans lequel ledit élément rotatif de sortie (60, 80, 84) est destiné à tourner autour d'un premier axe de rotation (26), et dans lequel lesdits premier et deuxième embrayages (56, 58) sont agencés à un espacement différent dudit premier axe de rotation.

9. Moteur à turbine (10), comprenant l'agencement à double embrayage selon la revendication 1, et comprenant en outre :

une section de compression (18) ;
un conduit de dérivation (44), entourant ladite section de compression et s'étendant le long d'un axe central (26) du moteur à turbine ; et
une première soufflante (16), destinée à diriger l'air dans ladite section de compression et ledit conduit de dérivation (44) ;
dans lequel l'élément rotatif de sortie (60, 80, 84) est un arbre de sortie accouplé à ladite première soufflante (16) ;
le premier élément rotatif d'entrée (66) étant un premier arbre d'entrée ; et

le deuxième élément rotatif d'entrée (30) étant un deuxième arbre d'entrée.

10. Moteur à turbine selon la revendication 9, dans lequel ledit premier embrayage (56) est positionné derrière ladite première soufflante (16), ledit deuxième embrayage (58) étant positionné devant ledit premier embrayage (56), le long dudit axe central (26).

11. Moteur à turbine selon la revendication 9, comprenant en outre :

un assemblage d'engrenage (42), destiné à transmettre la puissance vers le premier arbre d'entrée à partir d'un arbre basse pression du moteur à turbine.

12. Moteur à turbine selon la revendication 11, dans lequel ledit deuxième arbre d'entrée est en outre défini comme constituant ledit arbre basse pression.

13. Moteur à turbine selon la revendication 9, comprenant en outre :

une deuxième soufflante (14), positionnée devant la première soufflante (16) et entrainée en rotation par ledit deuxième arbre d'entrée (30).

14. Moteur à turbine selon la revendication 9, comprenant en outre :

un mécanisme de verrouillage (126), destiné à accoupler sélectivement ledit arbre de sortie et ledit deuxième arbre d'entrée en vue d'une rotation commune lorsque ledit deuxième embrayage (58) est engagé, en vue d'accroitre une importance du couple transmis entre ledit arbre de sortie et ledit deuxième arbre d'entrée.

15. Procédé, comprenant les étapes ci-dessous :

actionnement d'un moteur à turbine (10) afin de produire une poussée pour un véhicule ;
direction de l'air dans le moteur à turbine par l'intermédiaire d'une première soufflante (16) au cours de ladite étape d'actionnement ;
entraînement de la soufflante en rotation par l'intermédiaire d'un arbre basse pression (30) du moteur à turbine ; et
changement d'une vitesse de la première soufflante (16) au cours de ladite étape d'actionnement, pour changer un rapport de dérivation du moteur à turbine (10) sans changer une vitesse de rotation de l'arbre basse pression (30).

16. Procédé selon la revendication 15, comprenant en outre l'étape ci-dessous :

entraînement sélectif de la première soufflante (16) à travers au moins deux trajets séparés de transmission de puissance à partir de l'arbre basse pression (30).

17. Procédé selon la revendication 15, comprenant en outre els étapes ci-dessous :

agencement d'une deuxième soufflante (14) devant la première soufflante (16), le long d'un axe central (26) du moteur à turbine (10) ;
entraînement de la première soufflante (16) à travers au moins deux trajets séparés de transmission de puissance ; et
entraînement de la deuxième soufflante (14) à travers un nombre réduit de trajets de transmission de puissance par rapport aux trajets d'entraînement de puissance de la première soufflante (16).

18. Procédé selon la revendication 15, comprenant en outre l'étape ci-dessous :

entraînement de la première soufflante (16) à travers au moins deux trajets séparés de transmission de puissance ; et
verrouillage positif de la première soufflante (16) lorsque la première soufflante (16) est entraînée à travers un quelconque des au moins deux trajets séparés de transmission de puissance.

19. Procédé selon la revendication 18, dans lequel ladite étape de verrouillage positif englobe les étapes ci-dessous :

verrouillage de la première soufflante (16) pour une rotation à travers un premier trajet de transmission de puissance par l'intermédiaire d'un embrayage à verrouillage positif (56) ; et
verrouillage de la première soufflante (16) pour une rotation à travers un deuxième trajet de transmission de puissance par l'intermédiaire d'un mécanisme de verrouillage (126) distinct d'un embrayage (58) agencé le long du deuxième trajet de transmission de puissance.

20. Procédé selon la revendication 19, comprenant en outre l'étape ci-dessous :

activation de l'embrayage (58) agencé le long du deuxième trajet de transmission de puissance et du mécanisme de verrouillage (126) par l'intermédiaire d'actionneurs séparés.

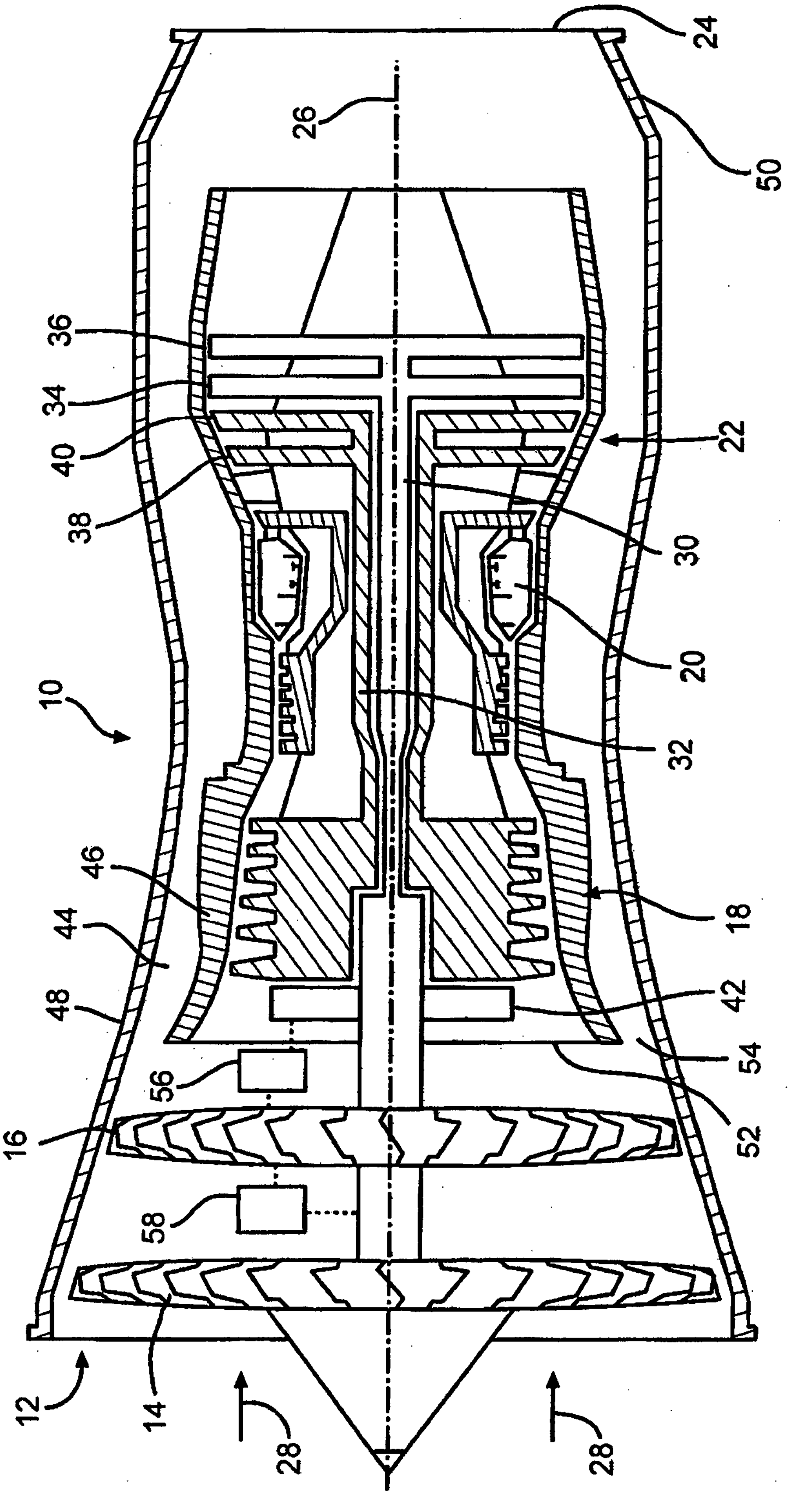
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FIG. 1

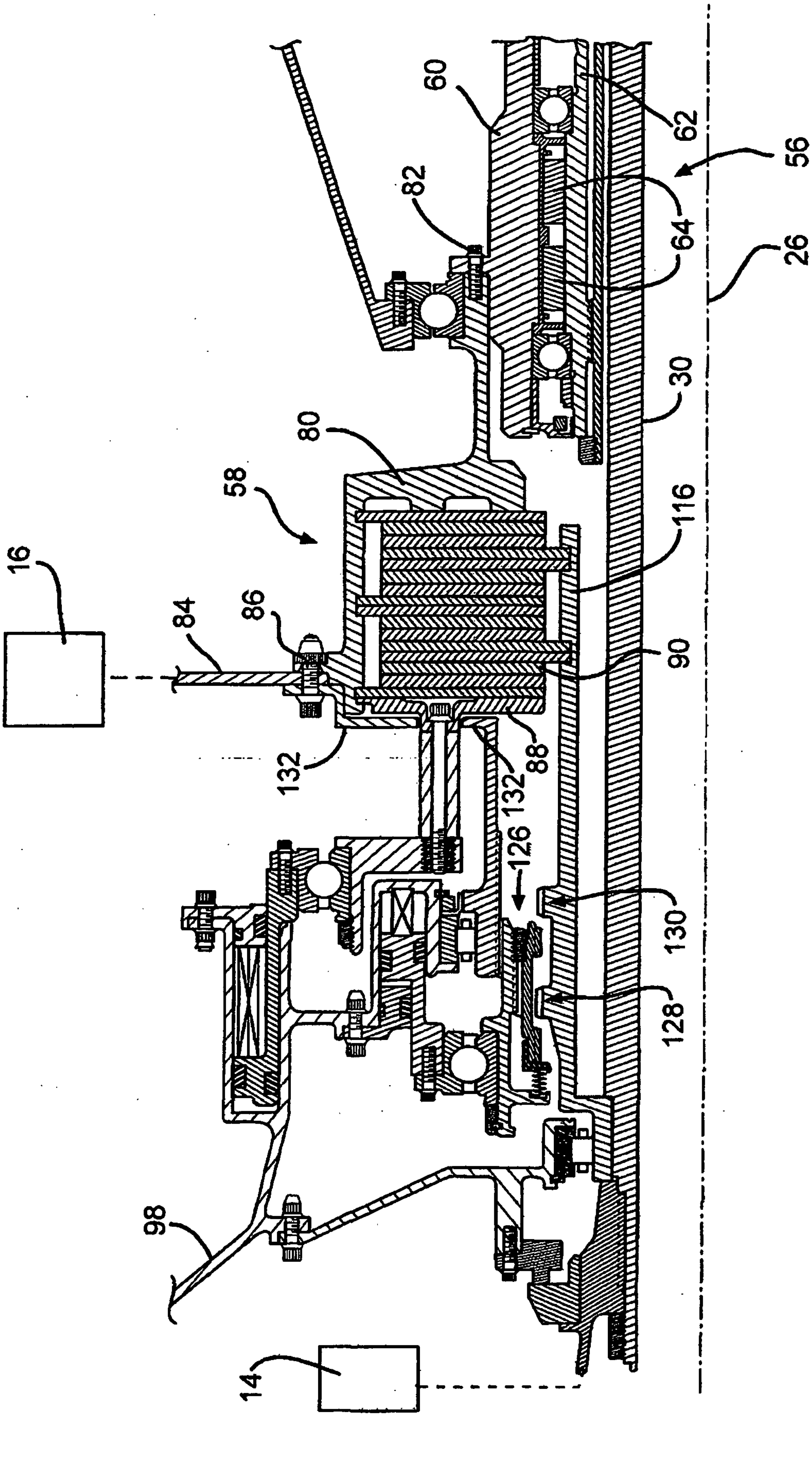
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FIG.2

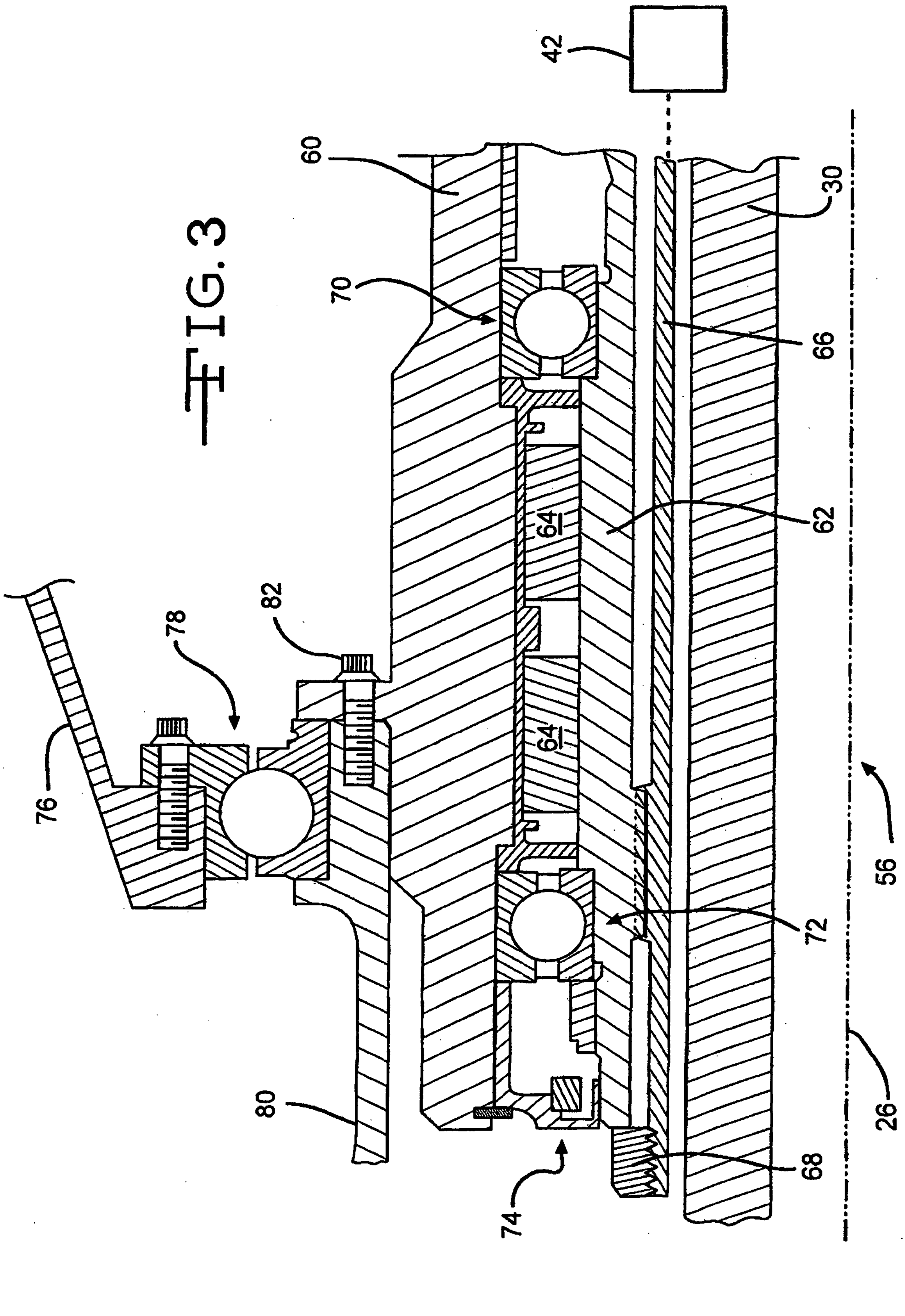

FIG. 3

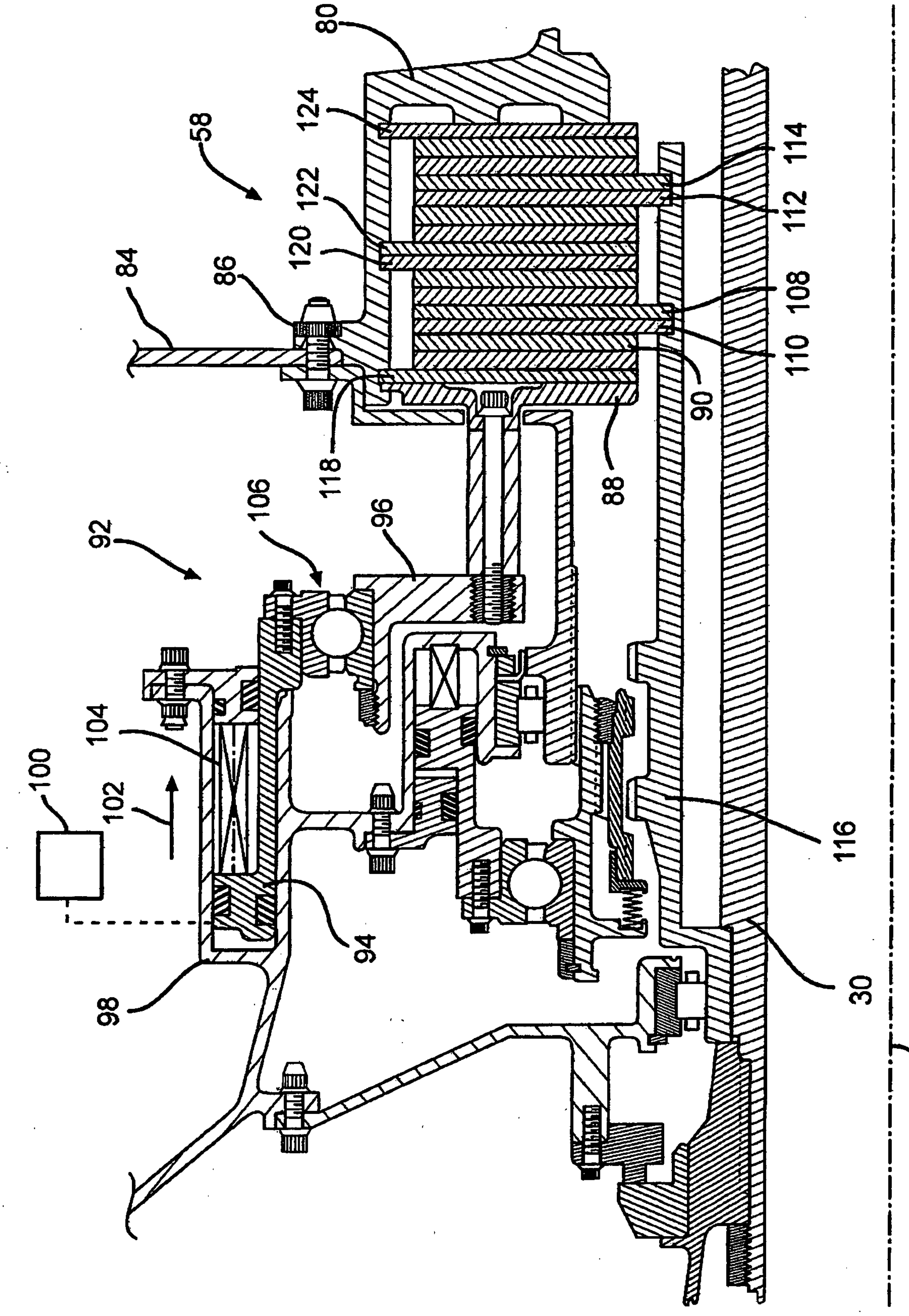
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FIG. 4

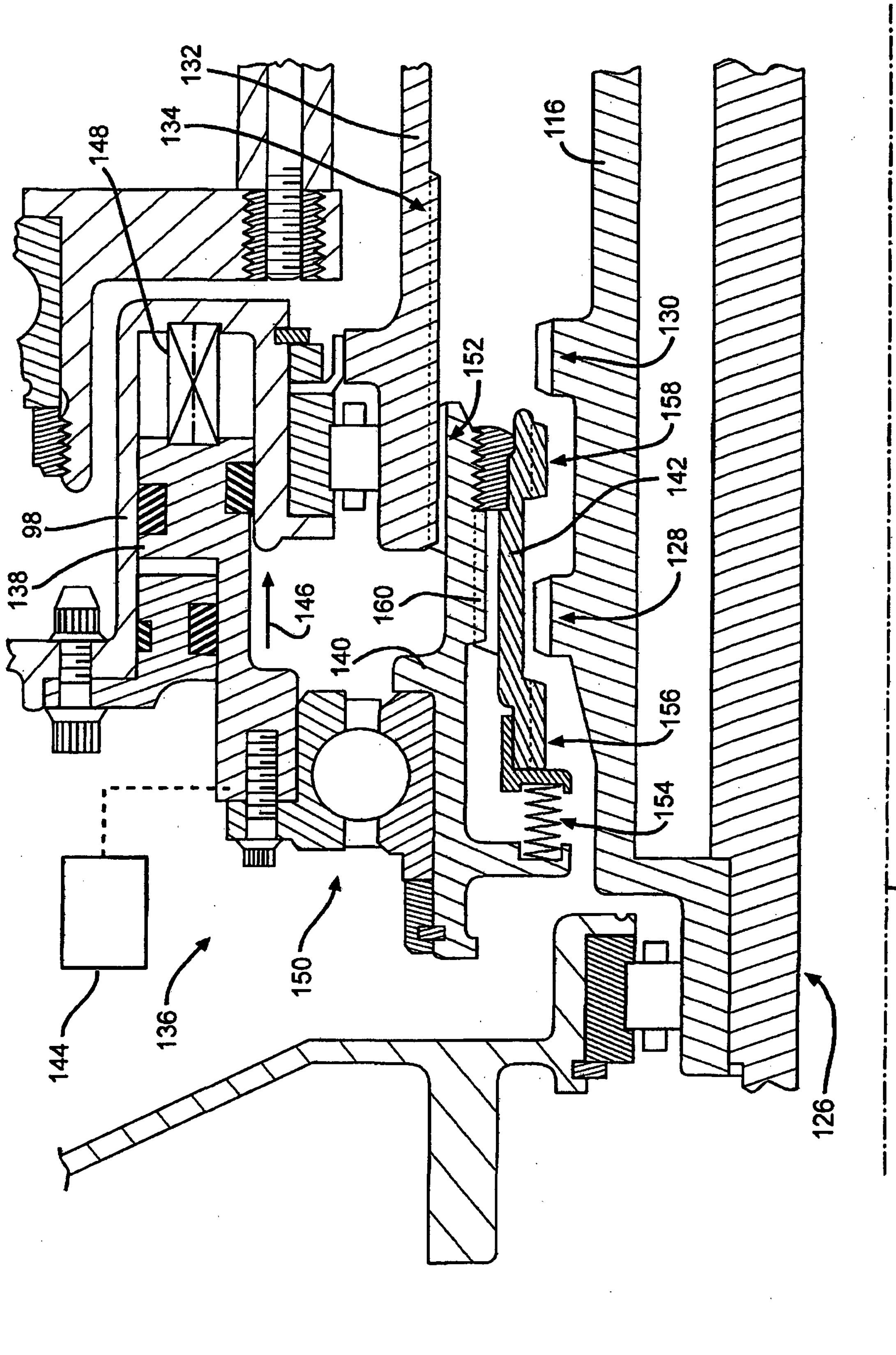
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FIG. 5

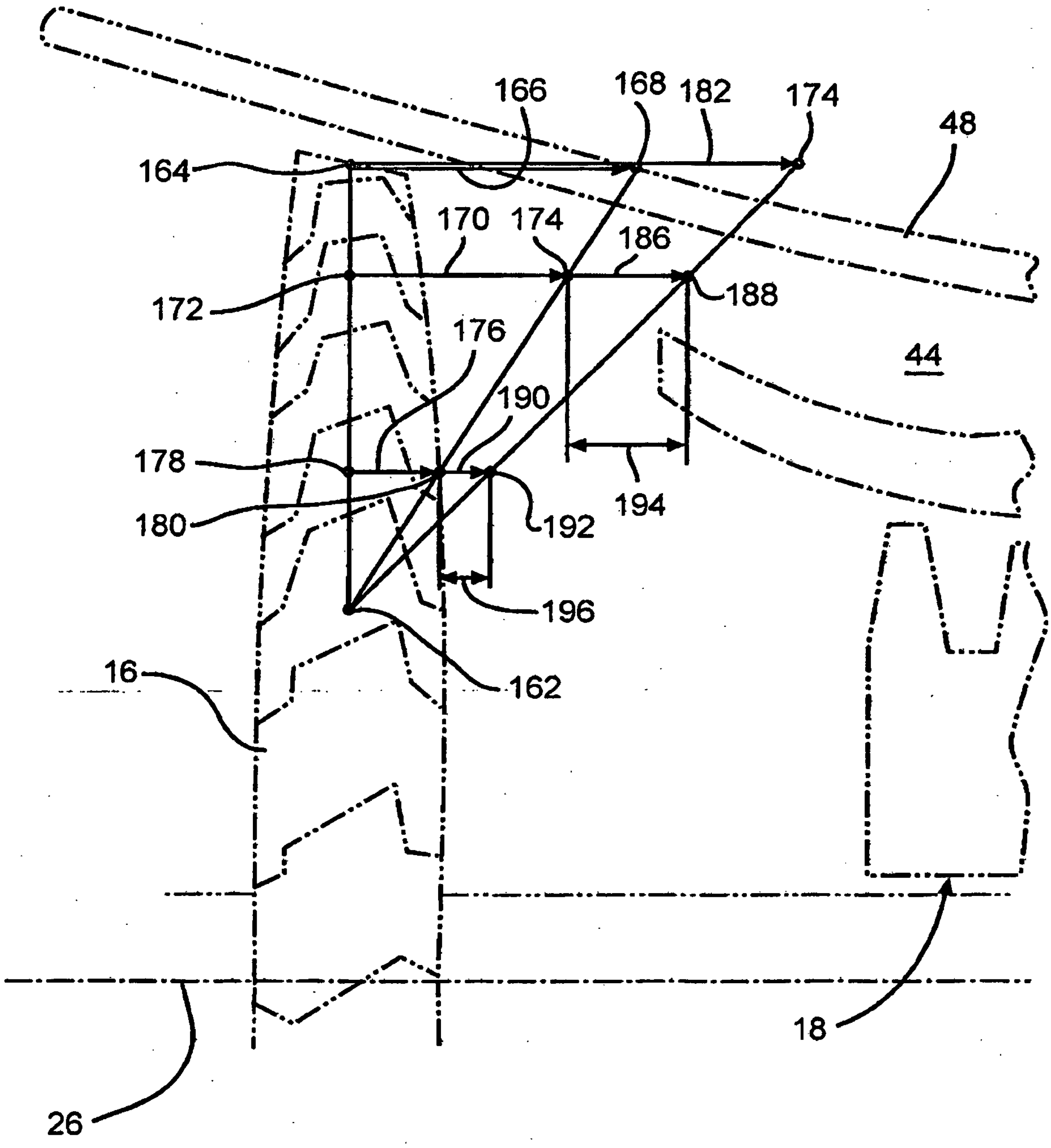
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FIG. 6

REFERENCES CITED IN THE DESCRIPTION

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